台灣農業研究 (J. Taiwan Agric. Res.) 74(4):449–458 (2025)
https://doi.org/10.6156/JTAR.202512_74(4).0005

Research Article

Etiology and Fungicide Screening of Avocado Leaf Spot Disease Caused by *Pseudoplagiostoma perseae*

Chao-Jung Wu[1,*], Sui-Li Hsu[2], and Su-Yu Lai[2]

Abstract

Wu, C. J, S. L. Hsu, and S. Y. Lai. 2025. Etiology and fungicide screening of avocado leaf spot disease caused by *Pseudoplagiostoma perseae*. J. Taiwan Agric. Res. 74(4):449–458.

Avocado leaf spot disease, caused by *Pseudoplagiostoma perseae*, is increasingly observed in avocado orchards across Taiwan. Despite its prevalence, limited information is available on disease dynamics and effective control measures. Field surveys conducted in this study revealed that disease severity peaks during the fall and winter, with disease decline occurring in spring. Laboratory assays showed that the optimal temperature for mycelial growth is 25℃, while the optimal temperature for spore germination ranges from 20℃ to 30℃. Pathogenicity tests confirmed that *P. perseae* induces characteristic pinpoint-like spots with yellow halos on the leaves of avocado cultivars 'Hass', 'Pinkerton', and 'Tainung No.1 Tasty Red' within 2 wk post-inoculation. Among the fungicides tested at 1 mg a.i. L^{-1}, pyraclostrobin completely inhibited mycelial growth. In addition, azoxystrobin, pyraclostrobin, trifloxystrobin, azoxystrobin + difenoconazole, fluopyram + trifloxystrobin, thiabendazole, and fluazinam completely suppressed spore germination at 1 mg a.i. L^{-1}. These findings contribute to a better understanding of the epidemiology of *P. perseae* and provide guidance for the development of effective disease management strategies in avocado cultivation.

Key words: Avocado, Leaf spot, Pathogenicity, Temperature, Fungicide.

INTRODUCTION

Avocado (*Persea americana* Miller) is one of the world's most economically important fruit crops, with global demand continuing to rise. In 2023, avocado fruit exports from Mexico increased by 27% compared to the previous year (FAO 2024). In Taiwan, the avocado cultivation area reached 2,062 ha in 2023, representing a more than 3.5-fold increase compared to 2013 (https://agrstat.moa.gov.tw/sdweb/public/inquiry/InquireAdvance.aspx). A diverse array of cultivars is grown in Taiwanese orchards, including 'Chang-an', 'Hung Shin Yuan', 'Hall', 'Choquette', 'Pinkerton', 'Tainung No. 1 Tasty Red', 'Tainung No. 2 Green Gold', and 'CAES-1' to 'CAES-4'.

Avocado leaves are susceptible to a range of fungal pathogens, with at least 6 species reported to cause leaf lesions or spots. *Sphaceloma perseae* causes black lesions that are localized to the midrib and main veins (Jenkins 1925, 1934). *Cercospora purpurea* produces light- to purplish-brown leaf spots often encircled by narrow yellow halos (Pohronezny *et al*. 1994). *Colletotrichum* spp., although mainly associated with postharvest fruit rot, can also infect leaves, initiating as yellow discolorations that progress

Received: May 13, 2025; Accepted: July 30, 2025.
* Corresponding author, e-mail: tcpq7410@tari.gov.tw
[1] Assistant Research Fellow, Department of Plant Protection, Chiayi Agricultural Experiment Branch, Taiwan Agricultural Research Institute, Chiayi, Taiwan, ROC.
[2] Project Assistants, Department of Plant Protection, Chiayi Agricultural Experiment Branch, Taiwan Agricultural Research Institute, Chiayi, Taiwan, ROC.

to brown necrotic lesions, especially at leaf tips (Dreistadt 2008; Giblins *et al*. 2010). Both *Bipolaris setariae* and *Corynespora cassiicola* cause pinpoint-like spots with yellow halos during early infection stages (Qiu *et al*. 2020; Wang *et al*. 2024).

Recently, *Pseudoplagiostoma perseae*, the causal agent of avocado leaf spot disease was identified in Taiwan (Wu *et al*. 2024). The initial symptoms present pinpoint-like spots with yellow halos, which develop into brown lesions with purple-brown margins and dark brown centers. This species is one of two *Pseudoplagiostoma* spp. reported to affect economic fruit trees. The other, *P. mangiferae*, was originally isolated from mango leaves exhibiting blight symptoms (Phookamsak *et al*. 2019), and its pathogenicity has been experimentally confirmed (Zhou *et al*. 2022). Cross-inoculation tests demonstrated that *P. perseae* and *P. mangiferae* exhibit host specificity, with infections restricted to their respective original hosts (Haituk *et al*. 2024; Wu *et al*. 2024).

Although several fungicides- mancozeb, carbendazim, prochloraz, and trifloxystrobin- effectively inhibit mycelial growth of both *Pseudoplagiostoma* species (Haituk *et al*. 2024), comprehensive knowledge regarding the epidemiology and management of *P. perseae* remains limited. This study aims to elucidate the field occurrence of *P. perseae*, determine the optimal temperature conditions for mycelial growth and spore germination, and evaluate the efficacy of selected fungicides for disease control.

MATERIALS AND METHODS

Field survey

The field surveys were conducted in Shanshang, Tainan (23°05'45.4"N, 120°21'42.1"E) and Chiayi City (23°29'6.79"N, 120°28'27.23"E). In Shanshang, Tainan, the survey period spanned from August 2020 to March 2021, whereas in Chiayi City, observations were carried out from August 2020 to August 2021. For each avocado cultivar surveyed, a minimum of four trees were examined. On each tree, 20 shoots were randomly selected, and 5 leaves per shoot were assessed for disease severities. Disease severity was categorized as follows: 0- no symptoms; 1- disease area covering 1 to 5% of the leaf area; 2- disease area covering 5 to 25%; 3- disease area covering 26 to 50%; 4- disease area exceeding 50%. Disease severity was calculated using the following formula: [Σ(leaf severity rating)/(total number of leaves × 4)] × 100%, where 4 represents the maximum disease severity score per leaf.

Effect of temperature on mycelial growth

P. perseae isolates V-019 and V-027 were used in this assay. The isolates were incubated at 25℃ for 2 wk. Fungal discs (0.5 cm in diameter) were cut from the colonies and placed on potato dextrose agar (PDA; Becton, Dickinson and Company, Franklin Lakes, NJ, USA). The plates were incubated in darkness at different temperatures, ranging from 10℃ to 40℃. Each temperature treatment included six replicates. Colony diameters were measured 21 d after incubation. The experiment was repeated twice.

Effect of temperature on spore germination

For sporulation, *P. perseae* isolates V-019 and V-027 were incubated in darkness at 25℃ for 21 d. A spore suspension was prepared using 0.02% Tween 20. The concentration of the spore suspension was adjusted to 5 spores μL^{-1}, and 100 μL of the suspension was evenly spread on a PDA plate. The plates were incubated at different temperatures, ranging from 10℃ to 40℃. Twenty-four hours after incubation, one hundred spores from each plate were examined under a microscope. A spore was considered germinated if its germ tube was at least 2.5 times longer than the spore itself. Each temperature treatment included six replicates, and the experiment was repeated twice.

Fungicide inhibition test on mycelial growth

The fungicides used in this assay included the following: 23.0% azoxystrobin suspension concentrate (SC; Syngenta Taiwan Ltd., Taipei,

Taiwan), 62.5% cyprodinil + fludioxonil water dispersible granules (WG; Syngenta Taiwan Ltd., Taipei, Taiwan), 70% thiophanate-methyl wettable powder (WP; Lih-Nung Chemical Co., Ltd., Yunlin, Taiwan), 23.6% pyraclostrobin emulsifiable concentrate (EC; Wonderful Agro Co., Ltd., Taichung, Taiwan), 40% iminoctadine tris WP (Sumitomo Cooperation Taiwan Ltd., Taipei, Taiwan), 25.9% tebuconazole emulsion (EW; oil-in-water; Bayer Taiwan Ltd., Taipei, Taiwan), 80.0% metiram WG (BASF Taiwan Ltd., Taipei, Taiwan), 50.0% trifloxystrobin WG (Bayer Taiwan Ltd., Taipei, Taiwan), 32.5% azoxystrobin + difenoconazole SC (Syngenta Taiwan Ltd., Taipei, Taiwan), 50.0% fluopyram + trifloxystrobin SC (Bayer Taiwan Ltd., Taipei, Taiwan), 40.0% thiabendazole WP (Fulon Chemical Industrial Co., Ltd., Taipei, Taiwan), and 39.5% fluazinam SC (ISK Taiwan Ltd., Taipei, Taiwan). Fungicides were added into PDA at concentrations of 1, 10, or 100 mg a.i. L^{-1}. PDA without fungicides served as the control treatment. *P. perseae* isolates V-019 and V-027 were cultured on PDA at 25℃ for 2 wk. Mycelial plugs (0.5 cm in diameter) were excised from the margins of actively growing colonies and placed onto PDA plates amended with the respective fungicides. After 2 wk of incubation at 25℃ in darkness, colony diameters were measured. Each treatment consisted of 6 replicates, and the entire experiment was repeated twice. The inhibition rate was calculated using the following formula: $[(C - T)/C] \times 100\%$, where C is the average colony diameter in the control and T is that in the treatment.

Fungicide inhibition test on spore germination

The preparation method for PDA plates containing fungicides was the same as that of the fungicide test on mycelial growth. Spores are suspended with 0.02% Tween 20 and adjusted to a concentration of 5 spores μL^{-1}. One hundred µL of spore suspension was spread evenly on a PDA plate containing fungicides. The plates were incubated at 25℃ in darkness for 24 h. The spore germination was inspected under a microscope. Each treatment included six replicates, and the experiment was repeated twice. The spore germination rate was calculated using the following formula: $[(Gc - Gt)/Gc] \times 100\%$, where Gc is the germination rate in the control and Gt is that in the treatment.

Pathogenicity assay

One-year-old seedlings of the cultivars ‘Hass’, ‘Pinkerton’, and ‘Tainung No.1 Tasty Red’ were used in the assay. For each cultivar, three plants were inoculated, with two young leaves per plant selected for inoculation. For sporulation, *P. perseae* isolate V-027 was incubated on PDA for 21 d at 25℃ in darkness. The inoculum was a spore suspension at a concentration of 2×10^4 spores mL^{-1}. The spore suspension was spread on both the upper and lower surfaces of young leaves until runoff. The negative control was treated with sterilized water. The inoculated leaves were sealed in zipper bags for 2 d. Symptoms were observed 14 d after inoculation. To fulfill Koch’s postulates, *P. perseae* was re-isolated from symptomatic leaf spots and identified based on its morphological traits and amplified *TUB* sequences. The experiment was repeated twice.

RESULTS

Field investigation

The investigation started in August 2020 in 2 orchards (Fig. 1). In the orchard in Chiayi City (Fig. 1A), the cultivars ‘Tainung No. 1 Tasty Red’, ‘CAES-4’, and ‘Pinkerton’ were examined. In October 2020, the disease severity exceeded 20% on ‘CAES-4’ and ‘Pinkerton’. From March to June 2021, the disease severity was less than 10% in all three cultivars, and the disease severity increased rapidly on ‘Pinkerton’ and ‘CAES-4’ in July 2021. The relative humidity, precipitation, and temperature of Chiayi City are shown in Fig. 1C. In the orchard of Shanshang, Tainan (Fig. 1B), the cultivars ‘CAES-2’, ‘Tainung No. 1 Tasty Red’, and ‘Hung Shin Yuan’ were examined.

In November 2020, the disease severity on 'Tainung No. 1 Tasty Red', and 'Hung Shin Yuan' was 25% and 30%, respectively. In August 2020 and March 2021, the disease severity of the three cultivars was less than 10%. The relative humidity, precipitation, and temperature of Shanshang, Tainan are shown in Fig. 1D.

The temperature effect on mycelial growth

The optimal temperature of mycelial growth for *P. perseae* was 25℃, and the growth rate was 3.8 to 4.0 mm d^{-1} (Fig. 2). The mycelial growth ceased at 35℃. While at 10℃, the mycelial growth was less than 1.0 mm d^{-1}.

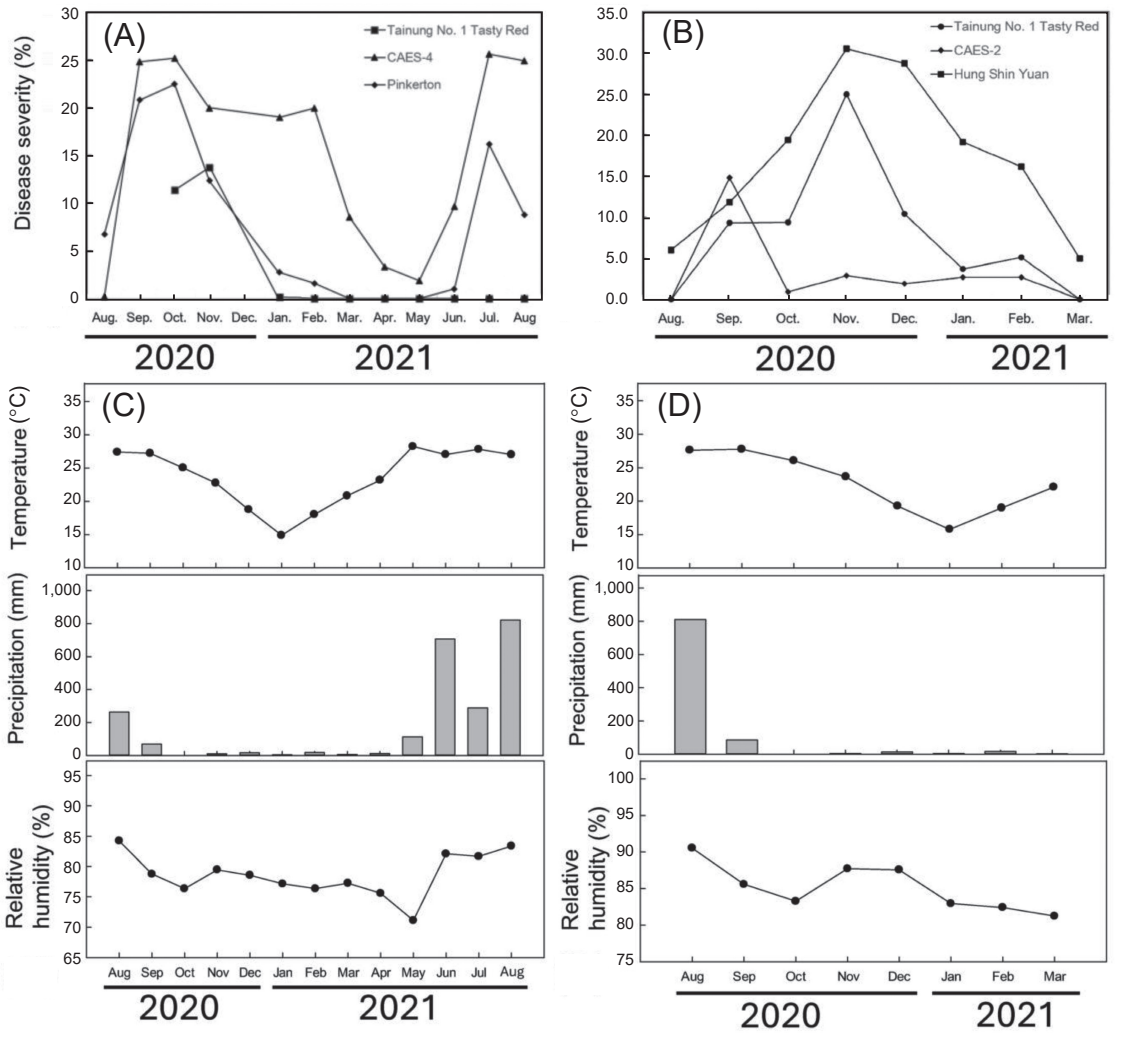

Fig. 1. Field survey of avocado leaf spot disease with weather data: (A) From August 2020 to August 2021 in Chiayi City; (B) from August 2020 to March 2021 in Shanshang, Tainan. The monthly average of relative humidity, precipitation, and monthly average of air temperature of (C) Chiayi city and (D) Shanshang, Tainan. Disease severity = [Sum of disease severity of investigated leaves/(total number of investigated leaves × 4)] × 100%.

The temperature effect on spore germination

The optimal temperature range for spore germination of *P. perseae* is 20 to 30℃ (Fig. 3). The germination rates of isolates V-019 and V-027 at 25℃ were 65.8% and 67.7%, respectively. At 35℃, the germination rate dropped to below 30%. The spore germination of *P. perseae* ceased at 10℃ and 40℃.

Pathogenicity test

Needle-like spots appeared on avocado cultivars 'Hass', 'Pinkerton', and 'Tainung No. 1 Tasty Red' 2 wk after inoculation with *P. perseae* (Fig. 4). On 'Hass' and 'Pinkerton' (Fig. 4A and 4B), the needle-like spots were surrounded by a distinct yellow halo. In contrast, the spots on 'Tainung No. 1 Tasty Red' were surrounded by a fuzzy halo or lacked a halo (Fig. 4C). The negative control, inoculated with sterilized water, showed no symptoms (Fig. 4D). To fulfill Koch's postulates, the symptomatic leaves were surface-disinfected, and fungi were re-isolated from the lesions. *P. perseae* was re-isolated from all inoculated leaves and identified based on colony morphology and β-tubulin (*TUB*) sequence.

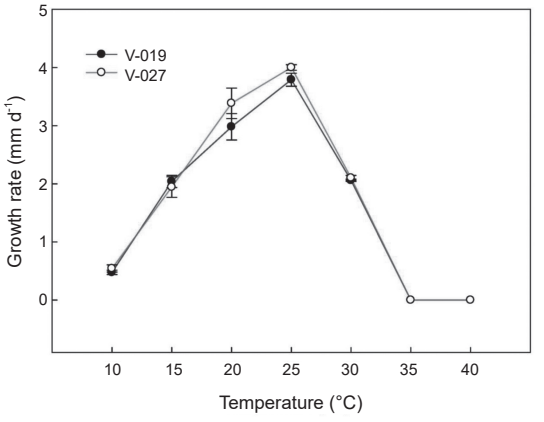

Fig. 2. Effect of temperature on mycelial growth of *Pseudoplagiostoma perseae* (isolates V-019, V-027).

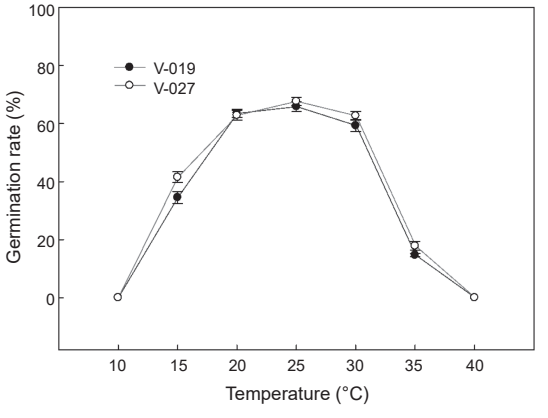

Fig. 3. Effect of temperature on spore germination of *Pseudoplagiostoma perseae* (isolates V-019, V-027).

Inhibitory effects of fungicides on mycelial growth

At a concentration of 1 mg a.i. μL^{-1}, pyraclostrobin effectively inhibited the mycelial growth of *P. perseae*, with an inhibition rate of 100% (Table 1). At 10 mg a.i. μL^{-1}, the inhibition rate of six fungicides, namely thiophanate-methyl, pyraclostrobin, iminoctadine-tris, tebuconazole, and azoxystrobin + difenoconazole, and thiabendazole, was 100%. At 100 mg a.i. μL^{-1}, all tested fungicides inhibited more than 80% of *P. perseae* mycelial growth, except for azoxytrobin, trifloxystrobin, and fluopyram + trifloxystrobin.

Inhibitory effects of fungicides on spore germination

At the concentration of 1 mg a.i. μL^{-1}, azoxystrobin, pyraclostrobin, trifloxystrobin, azoxystrobin + difenoconazole, fluopyram + trifloxystrobin, thiabendazole, and fluazinam effectively inhibited the spore germination of *P. perseae* (Table 2). At the concentration of 100 mg a.i. μL^{-1}, all tested fungicides completely inhibited spore germination, except for iminoctadine-tris. However, in iminoctadine-tris treatment, the spore germination rate was only 3.3% to 5.7%. The spore germination rate in the negative control (without fungicide application) ranged from 75.8% to 83.8%.

DISCUSSION

The avocado leaf spot disease caused by *P. perseae* has only been reported in Taiwan and

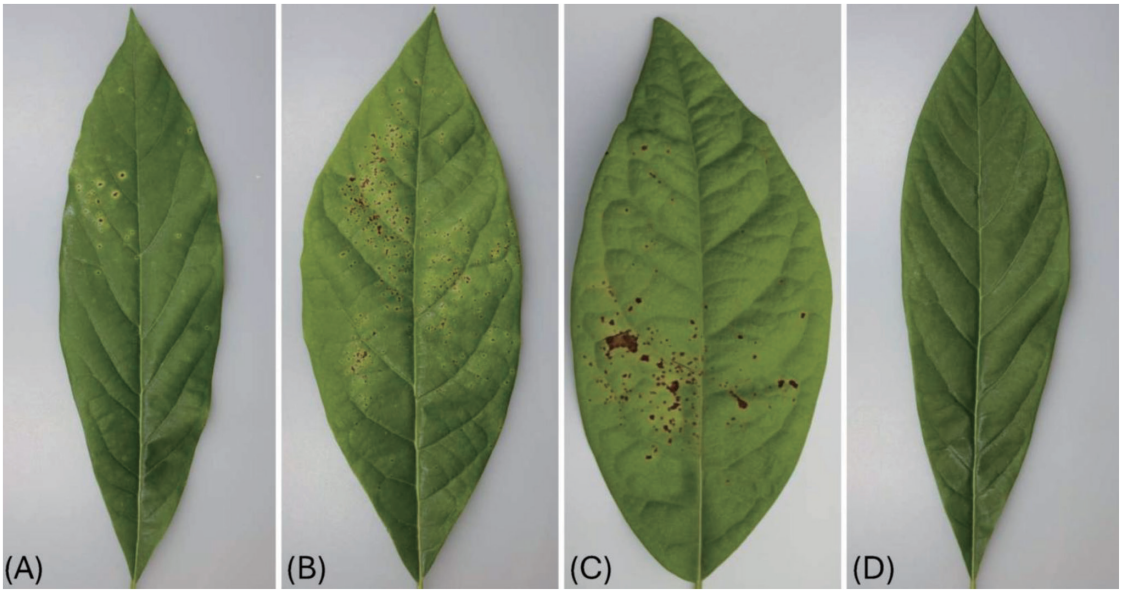

Fig. 4. Leaf symptoms of potted avocado cultivars inoculated with spore suspension of *Pseudoplagiostoma perseae*: (A) 'Hass'; (B) 'Pinkerton'; (C) 'Tainung No. 1 Tasty Red'; and (D) Negative control of a 'Hass' leaf inoculated by sterilized water.

Table 1. Effect of fungicides on mycelial growth of *Pseudoplagiostoma perseae*.

	Inhibition rate (%)[z]					
	1 ppm		10 ppm		100 ppm	
Treatment[y]	V-019	V-027	V-019	V-027	V-019	V-027
23.0% Azoxystrobin SC	50.1 de[x]	50.6 h	35.7 f	46.1 f	38.3 f	44.7 f
62.5% Cyprodinil + Fludioxonil WG	69.0 c	70.1 e	73.1 c	70.9 c	81.4 c	81.9 c
70.0% Thiophanate-methyl WP	67.8 c	62.2 f	100.0 a	100.0 a	100.0 a	100.0 a
23.6% Pyraclostrobin EC	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a
40.0% Iminoctadine-Tris WP	90.9 b	90.7 b	100.0 a	100.0 a	100.0 a	100.0 a
25.9% Tebuconazole EW	89.1 b	79.0 d	100.0 a	100.0 a	100.0 a	100.0 a
80.0% Metiram WG	5.8 f	1.9 i	15.8 g	12.8 g	87.9 b	89.8 b
50.0% Trifloxystrobin WG	51.9 d	58.3 g	52.0 d	58.9 d	57.7 e	62.1 e
32.5% Azoxystrobin + Difenoconazole SC	89.8 b	90.8 b	100.0 a	100.0 a	100.0 a	100.0 a
50.0% Fluopyram + Trifloxystrobin SC	48.2 e	49.8 h	47.4 e	49.5 e	71.7 d	77.7 d
40.0% Thiabendazole WP	90.7 b	89.0 bc	100.0 a	100.0 a	100.0 a	100.0 a
39.5% Fluazinam SC	89.1 b	88.2 c	90.3 b	89.8 b	90.7 b	89.9 b
LSD	2.3	2.4	2.5	2.7	3.6	2.5

[z] Inhibition rate (%) = $[(C - T)/C] \times 100\%$, where C is the average colony diameter in the control and T is that in the treatment.
[y] SC: suspension concentrate; WG: water dispersible granules; WP: wettable powder: EC: emulsifiable concentrate: EW: emulsion, oil in water; LSD: least significant difference.
[x] Means within a column followed by the same letter are not significantly different at 5% by Fisher's least significant difference test.

Table 2. Effect of Ffungicides on spore germination of *Pseudoplagiostoma perseae*.

	Spore germination (%)[z]					
	1 ppm		10 ppm		100 ppm	
Treatment[y]	V-019	V-027	V-019	V-027	V-019	V-027
23.0% Azoxystrobin SC	0.0 e[x]	0.0 f	0.0 e	0.0 e	0.0 c	0.0 c
62.5% Cyprodinil + Fludioxonil WG	26.2 c	18.9 d	0.0 e	0.0 e	0.0 c	0.0 c
70.0% Thiophanate-methyl WP	84.2 a	66.7 c	3.5 d	4.2 d	0.0 c	0.0 c
23.6% Pyraclostrobin EC	0.0 e	0.0 f	0.0 e	0.0 e	0.0 c	0.0 c
40.0% Iminoctadine-Tris WP	85.0 a	71.0 b	60.7 b	66.3 b	3.3 b	5.7 b
25.9% Tebuconazole EW	71.5 b	73.2 ab	57.0 c	53.2 c	0.0 c	0.0 c
80.0% Metiram WG	15.5 d	3.7 e	0.0 e	0.0 e	0.0 c	0.0 c
50.0% Trifloxystrobin WG	0.0 e	0.0 f	0.0 e	0.0 e	0.0 c	0.0 c
32.5% Azoxystrobin + Difenoconazole SC	0.0 e	0.0 f	0.0 e	0.0 e	0.0 c	0.0 c
50.0% Fluopyram + Trifloxystrobin SC	0.0 e	0.0 f	0.0 e	0.0 e	0.0 c	0.0 c
40.0% Thiabendazole WP	0.0 e	0.0 f	0.0 e	0.0 e	0.0 c	0.0 c
39.5% Fluazinam SC	0.0 e	0.0 f	0.0 e	0.0 e	0.0 c	0.0 c
CK	83.8 a	75.8 a	83.8 a	75.8 a	83.8 a	75.8 a
LSD	3.0	3.2	2.0	2.3	1.0	1.0

[z] Spore germination (%) = [(*Gc* − *Gt*)/*Gc*] × 100%, where *Gc* is the germination rate in the control and *Gt* is that in the treatment.
[y] SC: suspension concentrate; WG: water dispersible granules; WP: wettable powder; EC: emulsifiable concentrate; EW: emulsion, oil in water; CK: negative control; LSD: least significant difference.
[x] Means within a column followed by the same letter are not significantly different at 5% by Fisher's least significant difference test.

Thailand. In this study, the prevalence period of the disease was investigated in the field. Additionally, the optimal temperature for mycelial growth and spore germination was determined, which reveals the favorable conditions for disease occurrence. Twelve fungicides, registered and recommended in Taiwan, were examined for their ability to inhibit mycelial growth and spore germination. The result provides the growers with guidance on selecting appropriate fungicides for disease management.

In this study, the spore germination rate of *P. perseae* at 20℃ was approximately 63%, which is similar to the rates observed at 25℃ and 30℃. For many pathogenic fungi, such as *Colletotrichum siamense* and *Fusarium oxysporum* (Huang *et al*. 2020; Wu *et al*. 2020), 20℃ is generally not the optimal temperature for spore germination. Instead, temperatures above 25℃ are typically more favorable. Similarly, other pathogenic fungi, including *Neofusicoccum mediterraneum*, *Rhizoctonia solani*, and *Botrytis cinerea* (Thomidis *et al*. 2023; Abouzkhar *et al*. 2024), exhibit optimal mycelial growth between 25℃ and 30℃, and remain active even at 35℃. In contrast, mycelial growth of *P. perseae* ceases at 35℃. These results indicate that elevated temperatures are unfavorable for both spore germination and mycelial growth of *P. perseae*, which may consequently limit its disease development under high-temperature conditions.

For many plant diseases, prevalence is influenced by weather factors. For example, Fusarium head blight on wheat, caused by *Fusarium graminearum*, can be predicted using a logistic regression model that includes three weather-related factors: daily mean relative humidity, daily mean temperature, and the cumulative number of hours with temperatures below 9℃ (Shah *et al*. 2019). Disease outbreaks in host plants may also exhibit seasonal patterns. Grunberg *et al*. (2025) reported that

in the grass species tall fescue (*Lolium arundinaceum*), plant epidemics occurred seasonally, including anthracnose in spring, brown patch in mid-summer, and crown rust from late summer to fall. In this study, the severity of avocado leaf spot disease peaked in the fall and winter. Given that a relatively low temperature (20℃) promotes spore germination of *P. perseae*, and mycelial growth ceases at higher temperatures (35℃), it is reasonable to assume that lower temperatures benefit the development of avocado leaf spot disease. However, a rise in disease severity was observed in July 2021 in Chiayi City (Fig. 1A), suggesting that other factors, such as humidity, rainfall, sunlight intensity, plant cultivars, or cultivation practices, may also contribute to the disease occurrence.

In the fungicide screening assay, six fungicides effectively inhibited mycelia growth, and nine fungicides effectively inhibited spore germination at a concentration of 10 mg a.i. μL^{-1}. The results indicate that *P. perseae* is sensitive to most of the fungicides currently approved and recommended in Taiwan. In the study by Haituk *et al*. (2024), the mycelial growth of *P. perseae* was 100% inhibited by the fungicides mancozeb, carbendazim, prochloraz, and trifloxystrobin, with the inhibition assay for trifloxystrobin conducted at a concentration of 250 mg a.i. μL^{-1}. In this study, the mycelial inhibition rate of trifloxystrobin was only 57% to 62% at a concentration of 100 mg a.i. μL^{-1}. However, trifloxystrobin demonstrated 100% inhibition of spore germination at a concentration of 1 mg a.i. μL^{-1}. Among the twelve fungicides tested, pyraclostrobin and azoxystrobin + difenoconazole effectively inhibit both mycelial growth and spore germination. Carbendazim, thiophanate-methyl, and thiabendazole, which interfere with β-tubulin assembly during mitosis, were found to be effective against *P. perseae*. However, since resistance and cross-resistance to fungicides belonging to benzimidazoles and thiophanates were frequently reported (Putman *et al*. 2010; Lee *et al*. 2011; Fontaine *et al*. 2022), the above three fungicides should be used in rotation with other fungicides to prevent resistance development in the field.

This research provides information on the disease occurrence period in the field and identifies effective fungicides for disease control. However, disease management should be a comprehensive plan that considers both crop cultivation practices and fungicide application. In the future, field assays can be conducted to validate the effectiveness of fungicides in the field. Additionally, studying the impact of crop cultivation practices (such as fertilizer usage, irrigation, and pruning) on disease development would be valuable. The information will help growers establish an integrated management strategy.

CONCLUSION

In this study, field investigations of avocado leaf spot disease were conducted, revealing a seasonal prevalence in fall and winter. The optimal temperature for the mycelial growth of *P. perseae* was found to be 25℃, while the optimal temperature for spore germination ranges from 20℃ to 30℃. Pyraclostrobin completely inhibited the mycelial growth of *P. perseae* at a concentration of 1 mg a.i. μL^{-1}. Complete inhibition of mycelial growth was observed at 10 mg a.i. μL^{-1} with thiophanate-methyl, pyraclostrobin, iminoctadine-tris, azoxystrobin + difenoconazole, and thiabendazole. Spore germination of *P. perseae* is completely inhibited by azoxystrobin, pyraclostrobin, trifloxystrobin, azoxystrobin + difenoconazole, fluopyram + trifloxystrobin, thiabendazole, and fluazinam at a concentration of 1 mg a.i. μL^{-1}. These findings provide important insights into the seasonal dynamics of avocado leaf spot disease and identify effective fungicidal options for its management.

REFERENCES

Abouzkhar, F. A., I. Yangui, S. Hlaiem, O. Ezzine, and M. L. B. Jamâa. 2024. Culture media and temperature

effects on *Neofusicoccum mediterraneum*: Assessing mycelial growth and colony characteristics. Eur. J. Plant Pathol. 169:73–80. doi:10.1007/s10658-023-02806-9

Dreistadt, S. H. 2008. Integrated Pest Management for Avocados. University of California Agriculture and Natural Resources. Oakland, CA. 222 pp.

Fontaine, S., L. Caddoux, F. Remuson, and B. Barrès 2022. Thiophanate-methyl and carbendazim resistance in *Fusicoccum amygdali*, the causal agent of constriction canker of peach and almond. Plant Pathol. 71:785–792. doi:10.1111/ppa.13525

Food and Agriculture Organization of the United Nations (FAO). 2024. Major tropical fruits. Market review: Preliminary results 2023. https://openknowledge.fao.org/server/api/core/bitstreams/c03844d3-3dc6-4465-abf3-8c49947e77d8/content (visit on 3/23/2025)

Giblins, F. R., L. M. Coates, and J. A. G. Irwin. 2010. Pathogenic diversity of avocado and mango isolates of *Colletotrichum gloeosporioides* causing anthracnose and pepper spot in Australia. Australas. Plant Pathol. 39:50–62. doi:10.1071/AP09055

Grunberg, R. L., F. W. Halliday, K. R. O'Keeffe, B. N. Joyner, R. W. Heckman, and C. E. Mitchell. 2025. Disease epidemics and species interactions: A manipulation of seasonal establishment of fungal diseases in an old field. Ecology 106:e70051. doi:10.1002/ecy.70051

Haituk, S., A. Karunarathna, T. Wongwan, T. Promthep, S. Sittihan, H. A. Ariyawansa, ... R. Cheewangkoon. 2024. *Pseudoplagiostoma* causing leaf spot disease in key tropical fruit crops in Thailand. Plants 13:3379. doi:10.3390/plants13233379

Huang, C. W., J. H. Huang, Y. C. Li, C. W. Chen, and T. F. Hsieh. 2020. Pseudobulb rot of *Cymbidium* caused by *Fusarium oxysporum*. J. Taiwan Agric. Res. 69:65–76. (in Chinese with English abstract) doi:10.6156/JTAR.202003_69(1).0005

Jenkins, A. E. 1925. The avocado scab organism. Phytopathology 15:807.

Jenkins, A. E. 1934. A species of *Sphaceloma* on avocado. Phytopathology 24:84–85.

Lee, M. H., S. M. Pan, T. W. Ng, P. S. Chen, L. Y. Wang, and K. R. Chung. 2011. Mutations of β-tubulin codon 198 or 200 indicate thiabendazole resistance among isolates of *Penicillium digitatum* collected from citrus in Taiwan. Intl. J. Food Microbiol. 150:157–163. doi:10.1016/j.ijfoodmicro.2011.07.031

Phookamsak, R., K. D. Hyde, R. Jeewon, D. J. Bhat, E. B. Gareth Jones, S. S. N. Maharachchikumbura, ... J. Xu. 2019. Fungal diversity notes 929–1035: Taxonomic and phylogenetic contributions on genera and species of fungi. Fungal Divers. 95(1):1–273. doi:10.1007/s13225-019-00421-w

Pohronezny, K. L., G. W. Simone, and J. M. Kotzé. 1994. *Pseudocercospora* spot (blotch). p.79–80. *in*: Compendium of Tropical Fruit Diseases. (Ploetz, R. C., G. A. Zentmyer, W. T. Nishijima, K. G. Rohrbach, and H. D. Ohr, eds.) The American Phytopathological Society. St. Paul, MN. 88 pp.

Putman, A. I., G. Jung, and J. E. Kaminski. 2010. Geographic distribution of fungicide-insensitive *Sclerotinia homoeocarpa* isolates from golf courses in the Northeastern United States. Plant Dis. 94:186–195. doi:10.1094/PDIS-94-2-0186.

Qiu, F., G. Xu, C. P. Xie, X. Li, F. Q. Zheng, and W. G. Miao. 2020. First report of *Corynespora cassiicola* causing leaf spot on avocado (*Persea americana*) in China. Plant Dis. 104:1857–1857. doi:10.1094/PDIS-01-20-0127-PDN

Shah, D. A., E. D. De Wolf, P. A. Paul, and L.V. Madden. 2019. Functional data analysis of weather variables linked to *Fusarium* head blight epidemics in the United States. Phytopathology 109: 96–110. doi:10.1094/PHYTO-11-17-0386-R

Thomidis, T., I. Prodromou, M. Paresidou, and P. Damos. 2023. Effects of temperature and leaf wetness duration on pathogens causing preharvest fruit rots on tomato. J. Plant Pathol. 105:1431–1448. doi:10.1007/s42161-023-01443-9

Wang, X. Y., D. J. Tan, X. H. Tang, D. Y. Xu, Y. C. Lu, Z. Q. Yang, and T. Jiang. 2024. First report of leaf spot disease on avocado caused by *Bipolaris setariae* in China. Plant Dis. 108:2920. doi:10.1094/PDIS-12-22-2958-PDN

Wu, C. J., J. L. Chen, S. S. Tzean, and H. F. Ni. 2024. *Pseudoplagiostoma perseae* sp. nov. causes leaf spot disease on avocado leaves in Taiwan. Eur. J. Plant Pathol. 170: 617–629. doi:10.1007/s10658-024-02921-1

Wu, C. J., C. W. Huang, J. W. Chang, and H. F. Ni. 2020. Physiological characteristics, pathogenicity and fungicide sensitivity of *Colletotrichum siamense* causing lychee pepper spot disease. J. Taiwan Agric. Res. 69:11–24. (in Chinese with English abstract) doi:10.6156/JTAR.202003_69(1).0002

Zhou, Z. Y., W. C. Tsao, W. H. Chung, and C. L. Wang. 2022. First report of mango leaf blotch caused by *Pseudoplagiostoma mangiferae* in Taiwan. Plant Dis. 106:2749. doi:10.1094/PDIS-04-21-0778-PDN

酪梨葉斑病發生生態及藥劑篩選

吳昭蓉[1,*] 許淑麗[2] 賴素玉[2]

摘要

吳昭蓉、許淑麗、賴素玉。2025。酪梨葉斑病發生生態及藥劑篩選。台灣農業研究 74(4): 449–458。

酪梨葉斑病由真菌 *Pseudoplagiostoma perseae* 所引起，是臺灣酪梨園中常見病害。然而，本病之發生趨勢及有效藥劑之相關知識目前仍十分有限。本研究中，田間調查結果顯示秋、冬兩季為本病好發季節，春天時罹病度則會降低。病原菌菌絲生長之最適溫度為 25℃，孢子發芽最適溫度則為 20–30℃。將病原菌接種於酪梨品種「哈斯」、「平克頓」、「台農一號紅甘」之葉片上，接種 2 wk 後葉片上出現具黃暈之針點斑病徵。藥劑試驗結果，在藥劑濃度 1 mg a.i. L^{-1} 之條件下，百克敏可完全抑制菌絲生長，而亞托敏、百克敏、三氟敏、亞托待克利、三氟派瑞、腐絕及扶吉胺則可完全抑制孢子發芽。本研究之發現，有助於生產者擬定有效的防治策略。

關鍵詞：酪梨、葉斑、病原性、溫度、殺菌劑。

投稿日期：2025 年 5 月 13 日；接受日期：2025 年 7 月 30 日。

* 通訊作者：tcpq7410@tari.gov.tw

[1] 農業部農業試驗所嘉義農業試驗分所植物保護系助理研究員。臺灣 嘉義市。

[2] 農業部農業試驗所嘉義農業試驗分所植物保護系計畫助理。臺灣 嘉義市。